Abhrajyoti Kundu
Computer Science & IT (CS)

THEORY OF COMPUTATION-1: (GATE 2022) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) | CORRECT(10) | INCORRECT(5) | SKIPPED(2)

Q. 11

? FAQ | Solution Video | Have any Doubt ?

Let us consider the pushdown automaton $<Q, \Sigma, \Gamma, q_0, Z_0, \{q_2\}, \delta>$, where $Q = \{q_0, q_1, q_2\}$, $\Sigma = \{a, b, c\}$, $\Gamma = \{a, b, Z_0\}$ and let δ be as given in the following table.

[Note: σ represent alphabet a or b].

State	Input	Top of stack	Move
q_0	a	Z_0	(q_0, aZ_0)
q_0	b	Z_0	(q_0, bZ_0)
q_0	a	σ	$(q_0, a\sigma)$
q_0	b	σ	$(q_0, b\sigma)$
q_0	c	σ	(q_1, σ)
q_1	a	a	$(q_1, \in)$
q_1	b	b	$(q_1, \in)$
q_1	$\in$	Z_0	(q_2, Z_0)

Which of the following language is accepted by the given PDA?

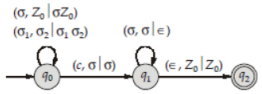
A $\{wcw^R \mid w \in (a, b)^* \mid w \mid \geq 0\}$

B $\{ww^R \mid w \in (a, b)^*\}$

C $\{wcw \mid w \in (a, b)^* \mid w \mid \geq 0\}$

D $\{wcw^R \mid w \in (a, b)^*$ and $\mid w \mid \geq 1\}$ — Correct Option

Solution :
(d)
The transition diagram of the PDA is as shown below. In the figure σ, σ_1 and σ_2 represent a or b.



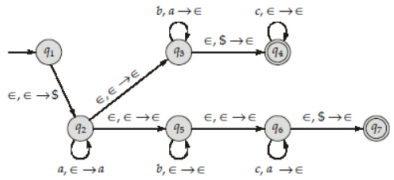
PDA accepting $\{wcw^R \mid w \in (a, b)^*$ and $\mid w \mid \geq 1\}$.

QUESTION ANALYTICS +

Q. 12

Solution Video | Have any Doubt ?

Consider the following automata that accepts the language L:



Which of the following is correct?

A $L = \{a^i b^j c^k \mid i, j, k \geq 1$ and $i = j$ or $i = k\}$

B $L = \{a^i b^j c^k \mid i, j, k \geq 1$ and $i = j$ and $i = k\}$

C $L = \{a^i b^j c^k \mid i, j, k \geq 0$ and $i = j$ or $i = k\}$ — Correct Option

Solution :
(c)
Given PDA is NPDA, hence two comparison with or is possible. If you observe the automata, at q_2 for every input 'a' there is two transition on epsilon which proves it is NPDA. The upper branch comparing a with b and lower branch comparing a with 'c' and both leads to the final states. L accepts epsilon as well. Hence $L = \{a^i b^j c^k \mid i, j, k \geq 0$ and $i = j$ or $i = k\}$.

D $L = \{a^i b^j c^k \mid i, j, k \geq 0$ and $i = j\}$

QUESTION ANALYTICS +

Q. 13 FAQ | Solution Video | Have any Doubt ?

Which of the following language generated by given grammar?

$S \rightarrow aA \mid bB \mid \in$

$A \rightarrow bC \mid aS$

$B \rightarrow aC \mid bS$

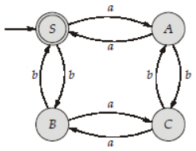
$C \rightarrow aB \mid bA$

A $L = \{w : n_a(w) \text{ and } n_b(w) \text{ both are even}\}$ — Your answer is **Correct**

Solution :

(a)

Since grammar is right linear regular grammar, convert it to machine.



Language is (a) $n_a(w)$ and $n_b(w)$ both are even.

B $L = \{w : n_a(w) \text{ and } n_b(w) \text{ both are odd}\}$

C $L = \{w : n_a(w) \text{ or } n_b(w) \text{ are even}\}$

D $L = \{w : n_a(w) \text{ or } n_b(w) \text{ are odd}\}$

QUESTION ANALYTICS +

Q. 14 FAQ | Solution Video | Have any Doubt ?

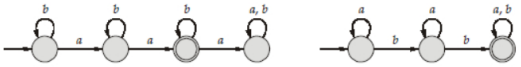
The minimum number of DFA states required for the languages $\{w \in (a, b)^* \mid$ has exactly two a's and at least two $b's\}$ is _____.

10 — Correct Option

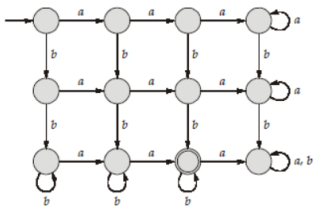
Solution :

10

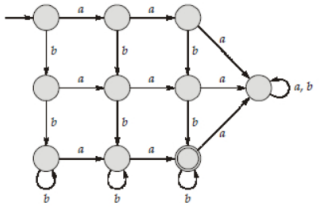
The following are DFAs for the two language $\{w \mid w$ has exactly two a's$\}$ and $w \mid w$ has at least two $b's\}$:



Combining them using the intersection construction gives the DFA:



Certain steps can be minimized



Hence total 10 states required.

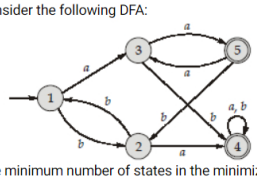
Your Answer is 6

QUESTION ANALYTICS +

Q. 15

FAQ | Solution Video | Have any Doubt ?

Consider the following DFA:



The minimum number of states in the minimized DFA is _____.

5 — Correct Option

Solution :

5

Make final non-final partition

[1, 2, 3] [4, 5]

Now, break because of $1 \xrightarrow{a} 3$ and 2, 3 goes to different states. So partition becomes

[1] [2, 3] [4, 5]

Break 4, 5 due to different transition on a. So partition becomes

[1] [2, 3] [4] [5]

Break [2] [3] because $2 \xrightarrow{a} 4$, $3 \xrightarrow{a} 5$

So [1] [2] [3] [4] [5]

Minimum 5 states will be required.

Your Answer is 4

QUESTION ANALYTICS +

Q. 16

FAQ | Have any Doubt ?

Consider the following grammar G:

$S \rightarrow PQ$

$P \rightarrow aPb \mid ab$

$Q \rightarrow bQc \mid \in$

Which of the following is true?

A $L(G) = \{a^m b^{m+n} c^n \mid m \geq 0, n \geq 0\}$

B $L(G) = \{a^m b^{m+n} c^n \mid m \geq 1, n \geq 0\}$ — Your option is **Correct**

C $L(G) = \{a^m b^n c^{m+n} \mid m \geq 1, n \geq 0\}$

D The string "ab" belongs to $L(G)$ — Your option is **Correct**

YOUR ANSWER - b,d | CORRECT ANSWER - b,d | STATUS - ✓

Solution :

(b, d)

$P \rightarrow aPb \mid ab$

mean $P \rightarrow \{a^m b^m \mid m \geq 1\}$

$Q \rightarrow bQc \mid \in$ mean

$Q \rightarrow \{b^n c^n \mid n \geq 0\}$

So $S \rightarrow PQ \rightarrow \{a^m b^m b^n c^n \mid m \geq 1, n \geq 0\}$

$\rightarrow \{a^m b^{m+n} c^n \mid m \geq 1, n \geq 0\}$

So option (b) is true.

Putting $m = 1$ and $n = 0$ "ab" belongs to $L(G)$ is true.

QUESTION ANALYTICS +

Q. 17

FAQ | Solution Video | Have any Doubt ?

Which of the following statement(s) is/are true?

A If L is regular language and F is a finite language (i.e. a language with finite number of words) the $L \cup F$ must be a regular language. — Your option is **Correct**

B Regular expression that do not contain the star operator can represent infinite languages.

C Regular expression that do not contain the star operation can represent only finite language. Your option is **Correct**

D If L is a regular language on F is a finite language then $L \cup F$ may or may not be regular language.

YOUR ANSWER - a,c | CORRECT ANSWER - a,c | STATUS -

Solution :
(a, c)

QUESTION ANALYTICS +